

## WHAT IS CLAIMED IS:

1 1. A storage controlling apparatus, disposed between  
2 a physical device and a host, for controlling an access  
3 from said host to said physical device, said storage  
4 controlling apparatus comprising:  
5       one or more host interface modules, connected  
6 to a plurality of channels of said host through a  
7 plurality of paths belonging to the same path group,  
8 for controlling an interface with said host;  
9       a management module for generally managing  
10 the whole of said apparatus;  
11       said management module comprising:  
12       a reconnection queue for enqueueing  
13 information on one or more input/output requests to  
14 be reconnected among input/output requests from said  
15 channels of said host as control blocks, and managing  
16 said enqueued control blocks;  
17       a monitoring means for monitoring the  
18 number of said enqueued control blocks in said  
19 reconnection queue;  
20       a controlling means, when an I/O  
21 process corresponding to one of said one or more  
22 control blocks managed in said reconnection queue is  
23 resumed, for controlling resumption of said I/O  
24 process in either a first system of issuing a  
25 reconnection request to each of said paths belonging

26 to the same path group one by one through said host  
27 interface module and requesting said host interface  
28 module to perform said I/O process using a path first  
29 successful in reconnection at the point of time that  
30 the reconnection succeeds, or a second system of  
31 issuing concurrently or almost concurrently the  
32 reconnection request to said plural paths belonging  
33 to the same path group through said one or more host  
34 interface modules and requesting said host interface  
35 module to perform said I/O process using a path which  
36 first succeeds in the reconnection; and

37           a switching means for dynamically switching  
38 the system to be executed by said controlling means  
39 to either said first system or said second system  
40 according to the number of the enqueued control blocks  
41 monitored by said monitoring means.

1 2. The storage controlling apparatus according to  
2 claim 1, wherein when the number of the enqueued  
3 control blocks monitored by said monitoring means is  
4 not larger than a predetermined number, said switching  
5 means switches the system to be executed by said  
6 controlling means to said first system, and when the  
7 number of the enqueued control blocks monitored by  
8 said monitoring means exceeds said predetermined  
9 number, said switching means switches the system to  
10 be executed by said controlling means to said second

11 system.

1 3. The storage controlling apparatus according to  
2 claim 1, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said first system is  
6 executed, said controlling means refers to said  
7 management table to issue the reconnection request to  
8 paths set free in said management table one by one  
9 through said host interface module.

1 4. The storage controlling apparatus according to  
2 claim 2, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said first system is  
6 executed, said controlling means refers to said  
7 management table to issue the reconnection request to  
8 paths set free in said management table one by one  
9 through said host interface module.

1 5. The storage controlling apparatus according to  
2 claim 1, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said second system is

6 executed, said controlling means refers to said  
7 management table to issue the reconnection request  
8 concurrently or almost concurrently to two or more  
9 paths set free in said management table through said  
10 one or more host interface modules.

1 6. The storage controlling apparatus according to  
2 claim 2, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said second system is  
6 executed, said controlling means refers to said  
7 management table to issue the reconnection request  
8 concurrently or almost concurrently to two or more  
9 paths set free in said management table through said  
10 one or more host interface modules.

1 7. The storage controlling apparatus according to  
2 claim 3, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said second system is  
6 executed, said controlling means refers to said  
7 management table to issue the reconnection request  
8 concurrently or almost concurrently to two or more  
9 paths set free in said management table through said  
10 one or more host interface modules.

1 8. The storage controlling apparatus according to  
2 claim 4, wherein said management module further  
3 comprises a management table for managing a use status  
4 of each of said paths through said one or more host  
5 interface modules, and when said second system is  
6 executed, said controlling means refers to said  
7 management table to issue the reconnection request  
8 concurrently or almost concurrently to two or more  
9 paths set free in said management table through said  
10 one or more host interface modules.

1 9. The storage controlling apparatus according to  
2 claim 1, wherein when said second system is executed,  
3 said controlling means successively requests the  
4 second and later paths which succeed in the  
5 reconnection to perform the I/O processes  
6 corresponding to one or more control blocks which can  
7 be reconnected among said control blocks managed in  
8 said reconnection queue.

1 10. A storage apparatus comprising:  
2 a physical device; and  
3 a storage controlling apparatus disposed  
4 between said physical device and a host to control an  
5 access from said host to said physical device;  
6 said storage controlling apparatus

7 comprising:

8                   one or more host interface modules,  
9 connected to a plurality of channels of said host  
10 through a plurality of paths belonging to the same path  
11 group, for controlling an interface with said host;

12                   a management module for generally  
13 managing the whole of said storage controlling  
14 apparatus;

15                   said management module comprising:

16                   a reconnection queue for  
17 enqueueing information on one or more input/output  
18 requests to be reconnected among input/output  
19 requests from said channels of said host as control  
20 blocks, and managing said enqueued control blocks;

21                   a monitoring means for  
22 monitoring the number of said enqueued control blocks  
23 in said reconnection queue;

24                   a controlling means, when an I/O  
25 process corresponding to one of said one or more  
26 control blocks managed in said reconnection queue is  
27 resumed, for controlling resumption of said I/O  
28 process in either a first system of issuing a  
29 reconnection request to each of said paths belonging  
30 to the same path group one by one through said host  
31 interface module and requesting said host interface  
32 module to perform said I/O process using a path first  
33 successful in reconnection at the point of time that

34 the reconnection succeeds, or a second system of  
35 issuing concurrently or almost concurrently the  
36 reconnection request to said plural paths belonging  
37 to the same path group through said one or more host  
38 interface modules and requesting said host interface  
39 module to perform said I/O process using a path which  
40 first succeeds in the reconnection; and

41                           a switching means for  
42 dynamically switching the system to be executed by  
43 said controlling means to either said first system or  
44 said second system according to the number of the  
45 enqueued control blocks monitored by said monitoring  
46 means.

1 11. The storage apparatus according to claim 10,  
2 wherein when said the number of the enqueued control  
3 blocks monitored by said monitoring means is not  
4 larger than a predetermined number, said switching  
5 means switches the system to be executed by said  
6 controlling means to said first system, and when the  
7 number of the enqueued control blocks monitored by  
8 said monitoring means exceeds said predetermined  
9 number, said switching means switches the system to  
10 be executed by said controlling means to said second  
11 system.

1 12. The storage apparatus according to claim 10,

2 wherein said management module further comprises a  
3 management table for managing a use status of each of  
4 said paths through said one or more host interface  
5 modules, and when said first system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request to paths set free in  
8 said management table one by one through said host  
9 interface module.

1 13. The storage apparatus according to claim 11,  
2 wherein said management module further comprises a  
3 management table for managing a use status of each of  
4 said paths through one or more said host interface  
5 modules, and when said first system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request to paths set free in  
8 said management table one by one through said host  
9 interface module.

1 14. The storage apparatus according to claim 10,  
2 wherein said management module further comprises a  
3 management table for managing a use status of each of  
4 said paths through said one or more host interface  
5 modules, and when said second system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request concurrently or almost  
8 concurrently to two or more paths set free in said



9 management table through said one or more host  
10 interface modules.

1 15. The storage apparatus according to claim 11,  
2 wherein said management module further comprises a  
3 management table for managing a use status of each of  
4 said paths through said one or more host interface  
5 modules, and when said second system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request concurrently or almost  
8 concurrently to two or more paths set free in said  
9 management table through said one or more host  
10 interface modules.

1 16. The storage apparatus according to claim 12,  
2 wherein said management module further comprises a  
3 management table for managing a use status of each of  
4 said paths through said one or more host interface  
5 modules, and when said second system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request concurrently or almost  
8 concurrently to two or more paths set free in said  
9 management table through said one or more host  
10 interface modules.

1 17. The storage apparatus according to claim 13,  
2 wherein said management module further comprises a

3 management table for managing a use status of each of  
4 said paths through said one or more host interface  
5 modules, and when said second system is executed, said  
6 controlling means refers to said management table to  
7 issue the reconnection request concurrently or almost  
8 concurrently to two or more paths set free in said  
9 management table through said one or more host  
10 interface modules.

1 18. The storage apparatus according to claim 10,  
2 wherein when said second system is executed, said  
3 controlling means successively requests the second  
4 and later paths which succeed in the reconnection to  
5 perform the I/O processes corresponding to one ore  
6 more control blocks which can be reconnected among  
7 said control blocks managed in said reconnection  
8 queue.

1 19. A reconnection controlling method in a storage  
2 apparatus comprising a physical device and a storage  
3 controlling apparatus disposed between said physical  
4 device and a host to control an access from said host  
5 to said physical device, comprising the steps of:  
6 enqueueing information on one or more  
7 input/output requests to be reconnected among  
8 input/output requests from a plurality of channels of  
9 said host as control blocks in a reconnection queue,

10 and managing said enqueued control blocks;  
11 monitoring the number of said enqueued  
12 control blocks in said reconnection queue; and  
13 resuming an I/O process corresponding to one  
14 of said one or more control blocks managed in said  
15 reconnection queue by dynamically switching,  
16 according to the number of said enqueued control  
17 blocks, to either a first system of issuing a  
18 reconnection request to each of paths belonging to the  
19 same path group one by one and requesting to perform  
20 the I/O process using a path first successful in  
21 reconnection at the point of time that the  
22 reconnection succeeds, or a second system of issuing  
23 the reconnection request concurrently or almost  
24 concurrently to said paths belonging to the same path  
25 group and requesting to perform the I/O process using  
26 a path which first succeeds in the reconnection.

1 20. The reconnection controlling method in a storage  
2 apparatus according to claim 19, wherein when the  
3 number of said enqueued control blocks is not larger  
4 than a predetermined number, said first system is  
5 switched to, and when the number of said enqueued  
6 control blocks exceeds said predetermined number,  
7 said second system is switched to.

1 21. The reconnection controlling method in a storage

2 apparatus according to claim 19, wherein a use status  
3 of each of said paths is managed in a management table;  
4 and

5           when said first system is executed, the  
6 reconnection request is issued to paths set free in  
7 said management table one by one.

1 22. The reconnection controlling method in a storage  
2 apparatus according to claim 20, wherein a use status  
3 of each of said paths is managed in a management table;  
4 and

5           when said first system is executed, the  
6 reconnection request is issued to paths set free in  
7 said management table one by one.

1 23. The reconnection controlling method in a storage  
2 apparatus according to claim 19, wherein a use status  
3 of each of said paths is managed in a management table;  
4 and

5           when said second system is executed, the  
6 reconnection request is issued concurrently or almost  
7 concurrently to two or more paths set free in said  
8 management table.

1 24. The reconnection controlling method in a storage  
2 apparatus according to claim 20, wherein a use status  
3 of each of said paths is managed in a management table;

4 and

5           when said second system is executed, the  
6 reconnection request is issued concurrently or almost  
7 concurrently to two or more paths set free in said  
8 management table.

1 25. The reconnection controlling method in a storage  
2 apparatus according to claim 21, wherein a use status  
3 of each of said paths is managed in a management table;  
4 and

5           when said second system is executed, the  
6 reconnection request is issued concurrently or almost  
7 concurrently to two or more paths set free in said  
8 management table.

1 26. The reconnection controlling method in a storage  
2 apparatus according to claim 22, wherein a use status  
3 of each of said paths is managed in a management table;  
4 and

5           when said second system is executed, the  
6 reconnection request is issued concurrently or almost  
7 concurrently to two or more paths set free in said  
8 management table.

1 27. The reconnection controlling method in a storage  
2 apparatus according to claim 19, wherein when said  
3 second system is executed, the second and later paths

4    which succeed in the reconnection are requested to  
5    perform the I/O processes corresponding to one or more  
6    control blocks which can be reconnected among said  
7    control blocks managed in said reconnection queue.